Valuing Environmental Policy Options: A Case Study Comparison of Multiattribute and Contingent Valuation Survey Methods

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ABSTRACT. *This paper describes a promising new evaluation approach, called a "value integration survey," that uses the objectives and tradeoffs expressed by participants to value environmental policy options. This constructive technique, which builds on the interactive elicitation process of decision analysts, assists stakeholders in clarifying their values and in agreeing on a policy alternative. The paper compares this multiattribute valuation method to contingent valuation surveys, describes the sequence of respondents' tasks, and presents results from a case study comparison of contingent valuation and value-integration survey methods in the context of valuing options for fire control in Oregon's old-growth forests.* (JEL Q26)

I. INTRODUCTION

Surveys are widely used to provide information about the attitudes, concerns, and values of the public on a variety of topics related to the management of natural resources. General attitude and opinion surveys have tracked dramatic changes in national environmental concerns over the past twenty years (Dunlap 1991) and many detailed surveys have provided insights into the environmental values associated with specific policy initiatives and regulations (Kopp and Smith 1993; Carson 1998).

Surveys generally are thought to work well as a means for collecting information about environmental choices to the extent that the expressed preferences of participants reflect support, opposition, or acceptance of well-understood activities or policies. Researchers have addressed many design considerations in an attempt to expand the domain of surveys (e.g., to novel policies or actions) and to enhance the predictive power of the results (Schuman and Presser 1981, 1996). Providing the design concerns are addressed, surveys have an advantage over revealed preference approaches in that they facilitate environmental valuations when information about actual choices is missing or partial.

Surveys also provide analysts with the ability to ask direct questions about the economic value of specific targeted environmental resources, thereby providing information that can be used as part of benefit cost analyses of project and program alternatives or economic assessments of resource losses. Contingent valuation methods, (CVM), the most widely-used economics survey approach (Mitchell and Carson 1989), typically ask a random sample of public respondents whether, in light of the associated benefits and costs, a specified environmental policy initiative should be undertaken. For example, after providing a detailed description of the problem, a CVM survey might ask whether the participant is willing to pay $X in additional taxes (or vote in favor of a referendum) for a stated improvement in a specific environmental-quality objective, such as water quality or visibility or species protection. Along with several other monetary-based

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survey approaches (e.g., using conjoint rating questions to construct a utility index; Roe, Boyle, and Teisl 1996), such economic methods now are widely used as part of policy assessments of a variety of environmental amenities critical to policy and project proposals.

Despite general enthusiasm for the use of surveys to incorporate public values into resource policy decisions, some researchers worry that current methods may fail to provide accurate measures for many complex environmental amenities. These concerns stem from the multiple dimensions of value attributed to many environmental assets (Fischhoff 1991) and the unfamiliar task of assigning monetary values to environmental resources not sold in conventional markets (Brown 1984; Gregory, Lichtenstein, and Slovic 1993). Economists and others interested in the development of CVM have made numerous design changes in an attempt to address these concerns (e.g., Ready, Whitehead, and Blomquist 1995; Hanemann 1995) and to improve the validity of CVM approaches.

A different response is to look to alternative value elicitation methods, based on extensive research by behavioral decision theorists and practitioners over the past 20 years (Kleindorfer, Kunreuther, and Schoemaker 1993). One focus of this work has been the development of multiattribute utility (MAUT) and decision analysis techniques for eliciting preference judgments over complex and poorly-defined options (Keeney and Raiffa 1993; vonWinterfeldt and Edwards 1986). Multiattribute approaches are often used to clarify the values of individuals as part of small-group negotiation processes, which is a significantly different valuation setting than that of a typical CV study (more on this point later). Another focus of behavioral decision research, (BDR), primarily by psychologists, has been an examination of the stability of attitudes, perceptions, and judgments. This research shows that preferences often are constructed in the process of elicitation and that they can be remarkably sensitive to the way a choice problem is described or framed (Payne, Bettman, and Johnson 1992; Slovic 1995).

These findings provide three key insights for the design and analysis of environmental valuation surveys. First, policymakers face a difficult challenge in crafting environmental policy alternatives that are responsive to the full range of stakeholders' concerns. In particular, the good under consideration should be defined clearly in terms of its objectives so that policy options can recognize these value dimensions, and so that tradeoffs across attributes can be addressed. Choice experiments (sometimes referred to as stated preference methods) also advocate a focus on attribute-based elicitation techniques (e.g., Adamowicz et al. 1998). The 1993 NOAA Panel report makes a similar point, arguing that the validity of responses to environmental survey questions depends on a clear understanding of the commodity to be valued and the scenario used to set a context for valuation (58 Fed Reg, 4604–5). I argue that a valuation method which is able to clarify both the good and survey participants' multiple dimensions of value, then address the key tradeoffs or value conflicts head-on and in a defensible manner, is preferred.

Second, the use of money as a numeraire in CVM follows the assumption of the social cost benefit framework that the relevant dimensions of the problem are commensurable with dollars as an index and that survey participants can formulate a meaningful economic response in terms of their willingness to pay.[1] CVM uses a rigorous logic to sum the individual consumer surplus responses of participants and thereby derive an estimate of the social value of the good in question. Extensive experimental evidence—joined by reasoning from psychology, behavioral economics, and law—argues that the use of a single dollar metric may be inconsistent with people's experience of valuing many amenity environmental goods (Ritov and Kahneman 1997; Schkade and Payne 1994). Sunstein 1994, for example, refers to the monetary basis of CBA valuation as being "obtuse," because "If all of the relevant

[1] This economic response also can be expressed in terms of their willingness to accept payment for a loss, keeping in mind that the WTA valuation response may exceed—often by a factor of three or more—the corresponding WTP response.

goods are aligned along a single metric, they become less visible, or perhaps invisible'' (842). Instead, he favors an approach that is explicitly constructive and that will allow people to see ''a disaggregated picture of the effects of different courses of action, so that officials and citizens can see those effects for themselves'' (857). I agree, and argue that a valuation method which is able to express multidimensional choices in either dollar or non-dollar terms (e.g., via multiple scales or attributes), and in ways that mirror how people naturally think about each dimension, is preferred.

A third issue concerns the selection of an acceptable environmental policy alternative. Because many considerations are important—relating to the economic (e.g., jobs, revenue) consequences of an option as well as a variety of noneconomic concerns (e.g., ecological impacts, social and community effects) and process considerations (e.g., which stakeholders are involved, the type of input they have)—asking individuals (as in CVM) to value a single, aggregated policy option ignores important information about value dimensions relevant to the creation of a best alternative. If input from survey participants instead allows a choice across different alternatives, possessing different mixes of the desired objectives, it can enhance policymakers' understanding of stakeholders' preferences for the competing choices. In addition, the inclusion of multiple alternatives permits stakeholders to participate more actively in the construction of a preferred environmental policy and to recognize more clearly their contribution to a final policy choice. As a result, I argue that an evaluation method which allows participants to select from multiple alternatives, displayed in terms of their disaggregated value dimensions, is preferable for many environmental policy choices.

This paper describes one promising new valuation approach, called a value integration survey (VIS), that adapts and builds on the interactive elicitation process developed by decision analysts to assist participants in identifying relevant objectives, establishing measurable attributes, and defining tradeoffs in the course of evaluating alternative environmental actions. A case study of the VIS method, in the context of valuing options for fire control in Oregon's old-growth forests, is presented and the results are contrasted to those obtained using a CVM survey instrument. This discussion has three parts: an analysis of quantitative results, including willingness-to-pay expressions of value; a comparison of value tradeoffs across dimensions; and a summary of participants' satisfaction with the two elicitation processes as a mechanism for valuing resource-management options. This comparison yields quite different insights than do comparisons across alternative CVM applications (e.g., Boyle et al. 1996). Final observations are provided in a concluding section.

II. THE BASIS FOR A VALUE INTEGRATION SURVEY APPROACH

The starting point for a VIS is the recognition that many values for complex environmental goods are not cognitively represented with precision or in terms that lend themselves readily to monetary valuation. This argues for reliance on a multiattribute, constructed survey approach as based in findings from cognitive psychology (Slovic 1995; Payne, Bettman, and Johnson 1993) and behavioral decision research (Keeney 1992; Gregory et al. 1995). Previous examples of the use of multiattribute methods to inform environmental policy options include studies by Keeney and Robilliard 1977, who evaluated the benefits of salmon preservation in the context of siting electric generation facilities; Keeney, von Winterfeldt, and Eppel 1990, who designed ''public value forums'' to assist the West German government in evaluating alternative energy policies; Gregory and Keeney 1994, who used decision analysis elicitations of stakeholder values to help create new policy alternatives in a controversial land use debate in Malaysia; McDaniels 1996a, who evaluated the environmental impacts of electric utilities; Maguire and Servheen (1992), who used decision analysis techniques to compare wildlife management options for endangered grizzly bear populations, and Wellman, Nugent, and Gregory (1997), who used a multiattribute

process to assess stakeholder values as part of a coastal estuary management plan.

These examples have demonstrated some of the strengths of a MAUT-based approach to valuing nonmarket resources: participants' values for goods or actions can be structured carefully, multiple measures can be used to express these objectives, and a variety of alternatives can be placed on the table for discussion and evaluation. These strengths are one of the reasons why MAUT-based processes are often favored for interest-group negotiations (Raiffa 1982; Fisher, Ury, and Patton 1991) and why the use of decision analysis techniques is fundamental to a growing number of stakeholder negotiations concerned with finding solutions to controversial environmental choices.

However, nearly all MAUT processes have involved well-informed individuals (typically experts or interested parties) in the context of small group settings. For many in the public policy arena, this is a disadvantage in that the process requires substantial dialogue between the analyst and respondents, favoring interactive elicitations rather than, for example, a written or telephone questionnaire, as the basis for estimating values. This detailed interaction has led to concerns about bias: if a different facilitator were to lead the group, or if the form of discussions among participants were slightly altered, would the same value structure and group priorities emerge? Another possible disadvantage is that (typically) only small numbers of individuals (often selected as representatives of identified stakeholder perspectives) are involved. This is not a disadvantage in the context of small-group negotiations, but it is viewed as a distinct disadvantage by many policymakers from local, state, and federal agencies who equate large random samples (and the statistical analyses they permit) with scientific precision and large-scale public involvement with an acceptable breadth of coverage. As a result, random surveys of large populations are a favored value elicitation approach in the realm of environmental decisions; in CVM surveys, for example, the participation of 1,500 or more respondents is not unusual.

These concerns pose challenges for the adaption of multiattribute procedures to the realm of environmental policy assessments. One response is to accept the traditional distinction between the use of MAUT procedures for small-group stakeholder negotiations and the use of CVM procedures for large-scale, random-sample surveys. Increasingly, however, there is a need for value elicitation techniques that can bridge this gap by combining an in-depth, constructive approach to value elicitation with the public-participation benefits of a general population survey. One such approach is the structured-value referendum; for example, McDaniels 1996b used structured small-group value elicitations as an input to the design of a general-population referendum on alternative sewage treatment options. Another response is to develop a branching question structure that simulates the detailed, explorative values dialogue of MAUT by creating "decision pathways" that can be selected by survey respondents. Gregory et al. 1997 provide a random telephone survey example of this multiattribute approach in the context of understanding forest vegetation management choices in Ontario.

The experimental VIS approach discussed in this paper represents another attempt to introduce the value-structuring capability of MAUT into a self-administered questionnaire that allows respondents to examine their own values and use them as building blocks in the creation of a favored policy option. The intent of the VIS approach is to provide participants with an opportunity to identify and to value their multiple objectives relevant to the policy decision and to use this disaggregated information to construct a preferred environmental policy alternative. Three primary steps in a VIS are described below.

1. Identifying objectives for the decision. This step develops a characterization of the valuation context in terms of participants' relevant objectives or dimensions of concern, which together describe why the problem matters. Typically, an environmental policy initiative will include economic, ecological, and social dimensions along with others specific to the problem at hand (e.g., health and safety concerns, equity, regional development, or polit-

ical dimensions). These can be expressed in the form of an objective function, in which each argument is a separate concern relevant to the decision. Decision analysts typically work with both utility functions, in which probabilities about consequences are represented explicitly, and value functions, which do not include uncertainties. Because the required judgments and elicitation procedures are more straightforward, value functions—and, in particular, additive value functions—typically are used when conducting multiattribute assessments of stakeholder objectives for issues of public interest (von Winterfeldt and Edwards 1986).

Comparison of the objectives across (and, sometimes, within) stakeholder groups can provide important insights into their reasons for supporting or opposing a suggested policy option. These reasons will be linked to revealed choices, but the significance of several decision factors—including the context in which the preference is revealed and the participant's access to information—means that choices may appear to be inconsistent in terms of an underlying set of values (Baron 1996). One important practical distinction for value elicitation is between fundamental or ends objectives, which are themselves important, and means objectives, which matter because they affect other values in turn (Keeney 1992). For example, the fundamental objectives in a watershed project might include protecting fisheries habitat, maximizing revenue from power sales, minimizing the frequency of floods, and incorporating learning into water-use plans. Means objectives might include increasing water quality, providing additional jobs, improving monitoring of rainfall, and maintaining flexibility in management over time. Another important distinction is to strive for independence across objectives, so that changes in impact levels affecting one objective do not automatically affect others. Failure to distinguish between objectives or between ends and means can result in double-counting some objectives, omitting others, and ignoring important policy relationships.

2. Making trade-offs across impacts on measured dimensions. The basic rationale for addressing tradeoffs is clear: the existence of tradeoffs across multiple objectives is what makes it difficult to come up with a broadly-acceptable policy option. Although large-scale tradeoffs across economic and environmental or health objectives may be considered cognitively intractable or even morally wrong (Baron and Spranca 1997), incremental tradeoffs (giving up a small amount of one objective in order to obtain slightly more of another) generally are feasible and can help participants to understand their own values better. This focus on tradeoffs at the margin is part of the shared conceptual foundation of both multiattribute decision theory and neoclassical microeconomics.

Operationalizing tradeoffs across objectives using a MAUT framework hinges on the specification of a functional form for the objective function. Once independence assumptions (relating to the definition of the objectives) have been shown to hold (Fishburn 1965) an additive utility function can be employed, written in the form

$$u(A_j) = w_i u_i(a_{ij}),$$

where $u(A_j)$ is the overall utility to a participant of alternative j; w_i is the weight of the i-th impact attribute ($i = 1, \ldots, n$); u_i is the utility function of the i-th attribute; and a_{ij} is the impact estimate of alternative j on attribute i.[2] Scaling constants or weights can be elicited from survey participants in several ways. One is to ask "even-swap" questions similar to "How much of a change in performance on Objective A is (in your view) equivalent to a specified change in performance on Objective B?" (Hammond, Keeney, and Raiffa 1998). Another approach, referred to as "swing weighting," assigns points of relative importance to changes in impacts that involve "swings" from the worst to best performance level on each objective (Von Winterfeldt and Edwards 1986). For example, stakeholders could be asked the utility (in relative terms) of a swing from the worst possible perfor-

[2] Whenever the a_{ij}'s are uncertain, the last term of the equation would be replaced by the expected utility of the probability distributions over single attribute impacts.

mance level of 100 acres on a habitat preservation objective to the best possible performance level of 1,500 acres. Sensitivity analysis then can be carried out to assess the implications of differences in the weights or impact estimates, as a guide to recognizing those aspects of the problem formulation that matter the most.

Note that participants in a VIS therefore make judgments across the dimensions of a choice rather than (as in CVM) a single, wholistic judgment of the worth of a policy option. The VIS emphasis is akin to obtaining a sequence of votes, asking participants to express their points of view on a series of difficult societal tradeoffs or to provide advice to decisionmakers about these tradeoffs. Although the values expressed in this manner typically are stated in a variety of units (e.g., using dollars for cost concerns, lives for health, numbers for fish production), the objective function allows conversion of all the values to equivalent dollars (through their successive translation, or "pricing out") so long as one of the objectives is expressed in dollar terms (Keeney and Raiffa, 1993).[3]

A substantial body of experimental evidence supports the direct comparison of multiple objectives in making a defensible choice. Recent work on this topic has been reported by Hsee (1996a, 1996b), who asked subjects to assume they were music majors looking for a music dictionary. In a joint-evaluation condition, participants were shown two dictionaries (A and B) and asked how much they would be willing to pay for each (see Table 1). Willingness to pay was higher for Dictionary B, presumably because of its greater number of entries. However, when one group of participants evaluated only A and another group evaluated only B, the mean willingness to pay was higher for Dictionary A. Hsee argues that this reversal provides evidence for the difficulty of making a choice based on the specified attribute for "number of entries" when the evaluator does not have a precise notion of how good or bad 10,000 (or 20,000) entries is. Thus, in the independent evaluation, more weight is given to the affective "defects" attribute, which translates easily into a good/bad response. Only under joint evaluation is the participant able to make an evaluative comparison and thereby see that option B is superior on the more important attribute.

TABLE 1

	Dictionary A	Dictionary B
Published	1993	1993
Number of entries	10,000	20,000
Defects?	No; like new	Yes; cover is torn

This example makes a strong case for the inclusion of explicit objectives for multiple decision alternatives. A secondary message of the example is the insight that a display of multiple objectives provides for respondents, who are able to make a more informed choice as a result of the disaggregated values and factual information that is provided to them.

3. Selecting a preferred alternative. The payoff for this hard work in identifying objectives and making tradeoffs across dimensions comes in the creation of alternatives which succeed to the extent they achieve the stated decision objectives. Experimental evidence (Jungermann, von Ulardt, and Hausmann 1983; Pitz, Sachs, and Heerboth 1980) demonstrates that additional policy alternatives will be considered when respondents are exposed to more and better specified objectives. These findings support the process of constructing preferences and suggest that, at minimum, the structured-value elicitation sessions included as part of a VIS can provide the basis for including alternatives that might have been ignored had less attention been given to identifying and articulating stakeholders' underlying concerns.

A related point concerns the distinction between values and facts in the decision process. Disputes between competing stakeholder groups generally are assumed to reflect differences in values and, as a result, negotiated solutions are thought to be hard to come by. In our experience, this assumption

[3] Conceptually, this "pricing-out" process for converting from tradeoff ratings or "votes" to dollar equivalents is similar to that used in conjoint analysis.

is not accurate; most environmental policy disputes reflect differences in the believability or interpretation of facts and many underlying values are shared (although the weights placed on these values may differ substantially). By making transparent the value dimensions that underlie policy choices and focusing the evaluation process on impacts that affect these values, it is far easier for stakeholders to keep in mind the commonality of their beliefs. As a result, participants are able to see that disagreements often are based in the interpretation of information (e.g., what an area may be like if a given alternative is chosen) rather than differences in underlying values (e.g., what individuals would like the area to be).

III. DESIGN OF THE VIS AND CVM SURVEY COMPARISON

Selection of a Case Study Context

The problem selected for the surveys is one of great interest to people living in the Pacific Northwest: the level of forest-fire protection provided in western Oregon's old-growth forests on federal lands. Over the past decade, a marked shift in forest practices has led to a substantial decline in the amount of timber harvested from old-growth forests on public lands. A primary reason is that, in the early 1990s, about 7 million acres of western old-growth forests were designated by the U.S. Fish and Wildlife Service as Northern Spotted Owl Critical Habitat Units (CHU). This designation eliminated most clear-cutting and severely restricted the harvest of timber from these lands.

The decline in allowable harvests has led many residents to view catastrophic fires as the primary source of disturbance for the remaining old-growth acreage. Fire management policies have become highly controversial, with substantive arguments over the nature of the impacts, their relative importance, and their associated degree of uncertainty. Some stakeholders, including many urban residents and tourist interests, would like to see most fires eliminated on federal lands and therefore favor a very restrictive fire control policy. Many ecologists have quite a different view, looking at fires as a natural part of the forest lifecycle and generally favoring a less restrictive fire control policy. In this view, small burns today lead to a more healthy forest tomorrow and decrease the probability of large, catastrophic fires. A third perspective, held by many loggers and timber industry representatives, also favors a less restrictive fire control policy because salvage logging—after a fire occurs—is one of the few remaining means for augmenting scarce supplies of timber. These different perspectives, and their mix of benefits, costs, and risks, add to the challenge of designing a valid survey instrument for eliciting public assessments of fire management options.

Design of the Contingent Valuation Survey

Design of the contingent valuation instrument used in this study benefitted greatly from an earlier CVM survey, funded by the U.S.D.A. Forest Service, of the value of protecting old-growth forests in the Pacific Northwest from fire (more complete descriptions of this survey are given in Loomis, Gonzalez-Caban, and Gregory 1994, 1996). The changes made from this earlier CV instrument are minor and reflect comments from two focus groups (conducted as part of this study), composed of paid citizen representatives recruited from the community. These groups were led by the first author and John Loomis, a respected CV researcher and lead investigator on the U.S.F.S. survey. The discussions clarified the level of information about fire control policies already known to participants and the types of additional information they sought in order to make more informed valuation judgments. In addition, the focus group discussions helped to refine quantitative scales for assessing participant satisfaction with the evaluation process (described in the next section).

The CVM survey designed for this study began by asking participants to rate reasons why they might value old-growth forests (e.g., recreation, timber harvest, habitat, jobs, scenic beauty) and to describe the relative importance of these reasons. Because it was expected that some participants would view

fires as beneficial, whereas others would view fires as harmful, depending on their values and the selected forest context, the CVM survey asked for ratings of the effect of fires on specified forest resources and activities using a scale ranging from "harmful" to "beneficial." Brief descriptions of the three main components of a proposed fire prevention and control program were then presented: greater fire prevention, earlier fire detection, and quicker fire response. Participants were told that additional funding in these three areas would reduce the average annual number of fires, (300), and the acreage burned, (7,000), in the Critical Habitat Units (CHU). To emphasize this point, a half-page map showing the CHUs was provided on the page of the survey directly across from the WTP question. Three versions of the questionnaire were developed, describing 25%, 50%, and 75% reductions in the average number of acres of CHUs burned each year.

The willingness-to-pay question was set up as a dichotomous-choice voter referendum, with annual costs per household varying from $2 to $200. Printed dollar amounts varied across the sample, to allow tracing out a demand relationship between the specified dollar amount and the probability of a positive response, following the basic relationship

$$\text{Prob(Yes)} = 1 - \{1 + \exp[B_0 - B_1X_1 + B_2X_2 + \ldots B_nX_n]\},$$

where X is the dollar amount the household is asked to pay and the B's are coefficients to be estimated using logit statistical techniques. All participants in the CV survey were reminded that "money you spend on the fire control program would reduce the amount of money your household will have available to spend." The summary WTP question, included for all respondents, then asked:

> Suppose this Oregon Old-Growth Fire Prevention and Control Program proposal was on the next ballot. This program would reduce by (one quarter, one half, or three quarters) the number of acres of old growth forests in Critical Habitat Units that burn in Oregon each year. If it cost your household $\$X$ each year, would you vote for this program?

Final questions in the CV survey asked standard demographic information on age, gender, education, and income levels as well as the participants' level of satisfaction with the survey instrument and with their participation (through the survey) in a public-policy debate. These questions and the satisfaction ratings of participants are discussed in Section 4.

Questionnaires were sent to a random sample of 600 Eugene, Oregon, households (200 × 3 protection levels). The sample was drawn from updated voter lists provided by the city of Eugene. Survey implementation procedures followed Dillman's Total Design Method (Dillman 1978), which includes a first mailing (along with a personalized cover letter on Decision Research letterhead), a reminder postcard (sent four days later), and a second mailing (sent to non-respondents after four weeks). After eliminating some returned surveys that were not complete, the final sample size was 180 (30% of the initial mailing). All participants were paid a small amount for their time.

Design of the Value Integration Survey

The first step in designing the VIS of fire control options was to conduct small-group workshops focusing on values elicitation. Three groups were run with paid volunteers from the community, using procedures based on the techniques of decision analysis. The groups were conducted either by the first author or by Ralph Keeney, a respected decision analyst, and all participants were paid for their time.

As with the CV questionnaire, these groups began with an introduction to the project context and the problem setting. Factual information about the valuation process, as well as about current fire control actions and the environmental resources at risk, was provided in response to questions from group participants. However, as noted in Section 2, the discussion of participants' objectives was more substantial and structured than for the

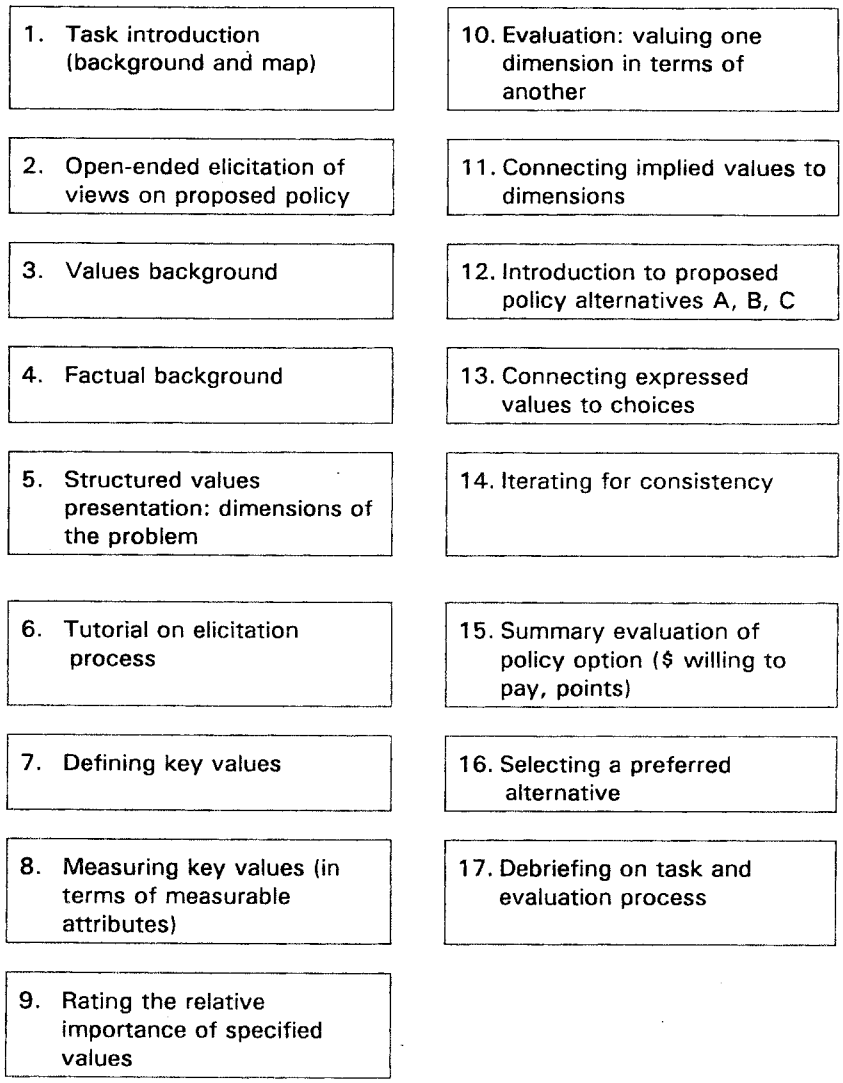

FIGURE 1
EXAMPLE SEQUENCE OF VALUE INTEGRATION SURVEY TASKS

CV survey. For example, additional questions were asked to clarify means-ends distinctions and to define relationships among value components.

This detailed values information was used to frame participants' entrance to the VIS. Consistent with the experimental nature of the approach, the survey sample included 14 individuals (in two groups of seven) who volunteered (for a small payment) to complete the value-integration questionnaire. These participants all responded to an advertisement asking for teachers from Oregon high schools; we considered this a representative group for testing the VIS approach even though some sample characteristics (e.g., education level) obviously would be different were individuals selected randomly.

As shown in Figure 1, the VIS survey began with a short description of the problem

and included the same map and introductory presentation used in the CV survey. The first portion of the VIS asked for an open-ended description of the value dimensions associated with fire protection for old-growth forests ("What kind of concerns come to mind when you think about old-growth forests?"). Participants next were asked to think about fire protection in terms of three general types of values: forest economic benefits, forest environmental quality, and forest fire-fighting costs. These values were defined in some detail and factual information was introduced for each value dimension. For example, the environmental quality objective "preserve old-growth forests" was defined as follows:

> The term "old-growth forests" refers to uncut sections of the forest in which the primary tree species—in western Oregon, generally Douglas fir—are mature and have reached a substantial size. Old-growth forests have unique biological properties and are home to several endangered animals and plants. For many people, old-growth forests also are valued as a special wild place where nature remains largely untouched by human intrusion.

Similarly, the fire-fighting objective "minimize dollar costs" was defined as follows:

> Fighting forest fires costs money. The more fire protection we seek, the more money that needs to be spent for training and equipping fire fighters, for airplane or helicopter flights, and for maintaining fire lookouts. As much as $1,000,000 a day can be spent fighting a large forest fire.

Following the introduction of additional factual information (keyed to the seven value dimensions) and a short tutorial on the proposed elicitation process, participants were asked to think about each value dimension in terms of specified attributes or "units of measurement." The analogy of measuring length by using inches was introduced as a familiar, common-sense example. The attributes included economic concerns, such as the number of full-time forest jobs and the dollar cost of protecting old-growth forests from fire; ecological concerns (e.g., preservation of critical animal habitat); and recreational sources of value (e.g., person-days of forest recreation). The objectives and the associated attributes, which serve as the basis for distinguishing among alternative policy options, are summarized in Figure 2. More detailed definitions of the attributes also were provided (see Figure 3) to ensure that all participants were thinking of the articulated value dimension in similar ways.

Next, importance weights were developed for each of the objectives, including the option of a "zero" weight for dimensions that individual participants considered to have no value for the fire control decision at hand. This critical aspect of the survey was one of the most challenging to set up as a paper and pencil task. Participants were first reminded that "value dimensions are of different importance to different people. We want to know what is important to *you*." The analogy of a car purchase was used to illustrate the idea of rating objectives by their importance. Participants were asked to consider three characteristics of a car—price, expected life span, and fuel economy—and, for each, to consider a worst and best conceivable outcome. For example, fuel economy for the cars under consideration was said to range from a worst outcome of 20 mpg to a best outcome of 32 mpg. Using a swing-weighting technique (as described in Section 2), participants were asked which of the three dimensions they most wanted to change from worst to best levels (in the context of the problem) and to assign this objective an arbitrary score of 100 points. The dimension valued next highest was rated proportionately; for example, if the change from worst to best level on the attribute mattered one-half as much, it received 50 points.

The translation of this example to the context of old-growth fire control was accomplished by asking participants to work with a set of seven cards, corresponding to the seven value dimensions. The task (similar to that used in contingent ranking exercises; see Smith and Desvousges 1986) is illustrated in Figure 4. Each card showed a worst and best outcome. Participants first were asked to arrange the cards, in rank order, and then to rate the dimensions by assigning them

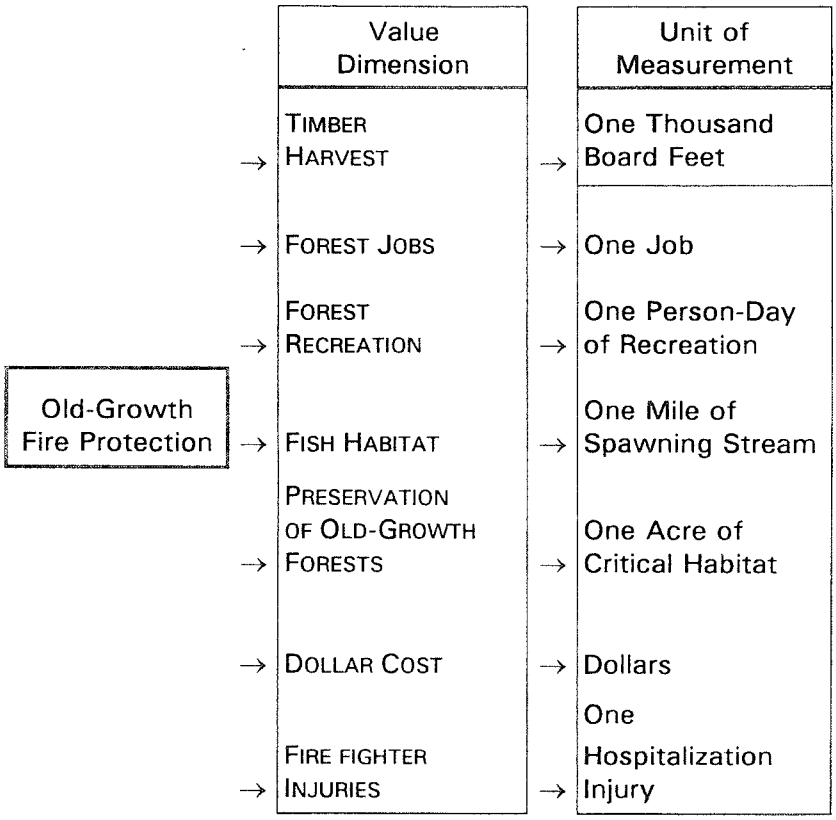

FIGURE 2
VALUE DIMENSIONS AND UNITS OF MEASUREMENT FOR THE VIS

descending value points. Participants were asked to keep in mind the range of attribute values that could be affected by the fire-control program. For example, although the creation of new fish-spawning habitat was considered to be very important, everyone was reminded that the habitat impacts of the specific program under consideration were relatively small. Respondents were given the opportunity to review factual information, based on their questions regarding the magnitude of expected project impacts, and also to make revisions in their expressed tradeoffs across value dimensions if they had learned more about their own values in the course of completing the questionnaire. This portion of the task ended with participants copying the resulting "value points," which provide the weighted importance values for each dimension, onto a summary table that provides relative values for all seven dimensions (Figure 5).

In a separate step, tradeoffs were made across dimensions using a two-step process to facilitate participant comprehension. Each person was asked to rank specified impact levels on each of three value dimensions. This part of the exercise was set up on large sheets of paper, with instructions shown at the top and a working table—on which calculations were to be made and results shown—included at the bottom. An arbitrary tradeoff value, shown for the "dollar cost" dimension, was selected on the basis of its ease of translatability. Participants were helped to work through an illustrative table, using the familiar car-purchase example, and

FISH HABITAT	Forest streams play an important role as habitat for fish such as salmon and trout. There are approximately 2,000 miles of high-quality spawning streams in Oregon forests. An average mile of stream provides habitat for approximately 1,000 fish that will survive to adulthood. Improvements to fish habitat are measured in units of *one mile of spawning stream.*
PRESERVATION OF OLD-GROWTH FORESTS	Old-growth forests are an important habitat for many types of plant and animal life, and are valued by many people because of their wildness and their freedom from human intrusion. Preservation of old-growth forests is measured in terms of *acres of critical habitat units.*
DOLLAR COST	Protecting old-growth forests from fires costs money. This money pays for firefighting equipment, for maintenance of firebreaks and lookouts, and for training fire workers. The unit of measurement for money is *thousands of dollars.*
FIRE FIGHTER INJURIES	Fire protection can impose risks on those who fight fires. Each year, approximately 50 fire fighters are injured while fighting fires in old-growth forests. Fire fighter injuries are those severe enough to result in *hospitalization.*
TIMBER HARVEST	Timber harvest is measured in terms of board feet. Actually, a board foot is a small amount of timber, a piece one foot long by one inch thick. Since a single tree provides many board feet of timber, the measurement of timber harvest is usually expressed in units of *thousands of board feet.*
FOREST JOBS	Forests are an important source of jobs. Some jobs are in the timber industry, such as logging and mill work. Other jobs are created in recreation. Though forest jobs are both part-time and full-time, when we discuss forest jobs we mean a *full-time job.* It may take two or more part-time jobs to equal the equivalent of a full-time job.
FOREST RECREATION	Forests are an important source of recreation for hiking, boating, hunting and other outdoor sports. Opportunities for forest recreation are measured by a *person-day of recreation,* that is, an opportunity for one person to spend one day recreating in the forest.

FIGURE 3
DETAILED DESCRIPTION OF VALUE DIMENSIONS AND MEASUREMENT UNITS

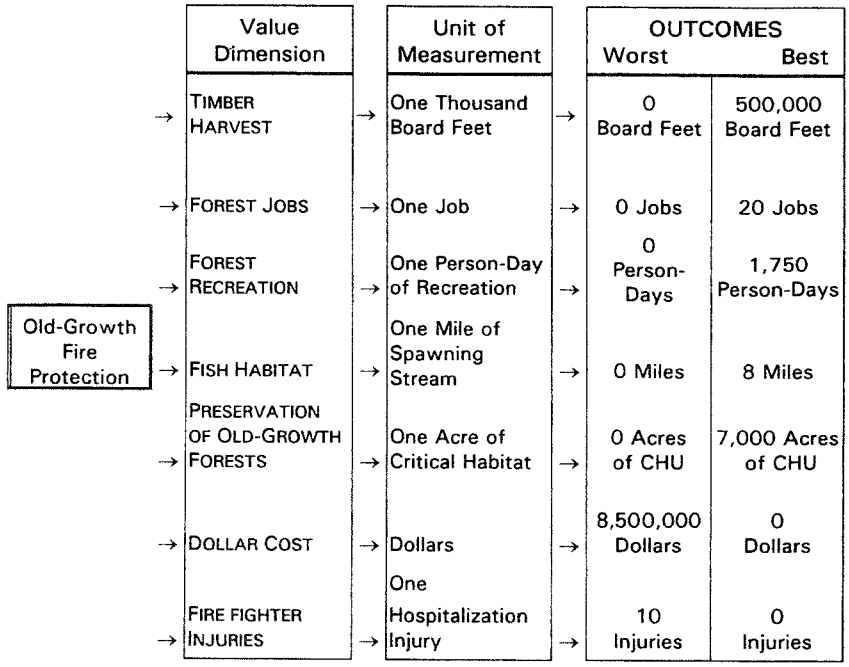

FIGURE 4
IMPACT RANGES FOR VALUE DIMENSIONS

then were asked to complete value comparisons for the old-growth fire example. Each of these required a trade-off across three value dimensions (see Figure 6).

Participants next were given a short writing task, to remind themselves again of their objectives ("some of the things that you think are important in making such an assessment") and to enforce a short break from the monotony of following instructions and filling in designated boxes. They were next asked to put themselves in the position of someone such as the state governor, "deciding where to spend scarce state funds this year." Focusing on the monetary worth of a forest job, participants worked through a multi-stage process in which they first oriented themselves by selecting a broad level of benefits (e.g., hundreds of dollars?; thousands of dollars?; millions of dollars?) appropriate to the creation of a single forest job.[4] This type of categorical decision, related to benchmark values, is easier than selecting from a continuous scale and thus simplified the cognitive demands of the evaluation task. Next, participants narrowed the range by providing an estimate of the minimum and maximum value of a forest job. Finally, each participant stated (within this range) their best assessment of what a single forest job was worth. This value then could be used to calculate a value for each of the other six dimensions, given the relative trade-off values that earlier had been assigned.

By this point, each participant had spent

[4] At the time of this study, a major initiative was underway in Oregon to create new jobs for forest sector workers, in part through the allocation of state funds, due to the presumed benefits provided by these jobs for other residents of the state. As a result of the emphasis given to job creation in the media, focus group participants identified this framing of stating a dollar value for a forest job as both straightforward and appealing. In hindsight (and for future applications), we recommend the choice of a different dollar-based attribute (such as personal incomes, state and county revenues, or commercial fishing profits) because of the disutility associated with some forest sector jobs and the salient opportunity costs of the job creation funds.

Value Dimension	Unit of Measurement	Value Points
TIMBER HARVEST	One Thousand Board Feet	[___]
FOREST JOBS	One Job	[___]
FOREST RECREATION	One Person-Day of Recreation	[___]
FISH HABITAT	One Mile of Spawning Stream	[___]
PRESERVATION OF OLD-GROWTH FORESTS	One Acre of Critical Habitat	[___]
DOLLAR COST	Dollars	[___]
FIRE FIGHTER INJURIES	One Hospitalization Injury	[___]

FIGURE 5
RELATIVE IMPORTANCE OF VALUE DIMENSIONS

between 75 and 90 minutes on the survey. In their own time, each individual now took a short break while their booklets were collected by the facilitators. Using the individualized tradeoff responses, a value was calculated, in dollars per unit, for each of the dimensions and these entries were written on a separate page of the notebook.[5] After the break, participants were asked to begin again by reviewing their own evaluations carefully (Do any values seem too large? Too small?), and to make any necessary changes in the relative value estimates. Most participants made minor changes in the tradeoff (relative) values at this time, and two people adjusted the value of a forest job (which required a quick recalculation for the other value dimensions).

Once individuals felt comfortable with the relative worth assigned to one unit of each of the seven value dimensions, they were ready for the final survey task: selecting and valuing their preferred fire control policy (Figure 7). In this experimental VIS, the three options reflected the range of preferred policies favored by participants in the small groups and considered realistic by the regional VSFS office. Ideally, a wider range of options would have been evaluated (see Section 5) or participants would have the option of creating new alternatives by combining di-

[5] In more recent tests of the VIS method this computational task has been simplified and conducted by the participants, either using a computer or as a paper-and-pencil task.

Value Dimension	Impact	Rank	Tradeoff
DOLLAR COST	save $50,000 in firefighting costs		$50,000
TIMBER HARVEST	gain 10,000 board feet of timber harvest		
FOREST RECREATION	gain 100 person-days of forest recreation		

FIGURE 6
TRADEOFFS ACROSS FIRE CONTROL VALUE DIMENSIONS

Value Dimension	Unit of Measurement	Fire Protection Program A	B	C
TIMBER HARVEST	One Thousand Board Feet	800	500	300
		Thousand board feet		
FOREST JOBS	One Job	15	8	4
			Jobs	
FOREST RECREATION	One Person-Day of Recreation	1,375	750	250
		Person-days of recreation		
FISH HABITAT	One Mile of Spawning Stream	6.5	4	1
		Mile(s) of spawning stream		
FOREST PRESERVATION	One Acre of Critical Habitat	5,250	3,500	1,750
		Acres of critical habitat		
DOLLAR COST	Dollars	7,750	6,000	4,250
		Thousand Dollars		
FIRE FIGHTER INJURIES	One Hospitalization Injury	9	6	3
		Hospitalization injuries		

FIGURE 7
ALTERNATIVE FIRE PROTECTION DESCRIPTION PROGRAMS

mensions across the options, thereby suggesting new combinations.[6]

The final, quantitative evaluation of the three fire control programs was followed, as in the CV survey, by a debriefing on the elicitation that included a series of questions designed to assess participants' level of satisfaction with the process. These questions included participants' confidence in their stated willingness-to-pay responses, whether the process helped to clarify their values, and whether the factual information provided to them was sufficient. Results are presented in the next section.

IV. COMPARISON OF RESULTS

The discussion in this section compares the results of the VIS and CVM survey approaches. The small number of participants in this initial methodology development case study of the VIS argues against reliance on the MAUT results for policy purposes. However, the implications of the inter-method comparisons are generally supportive of the search for a value- and attribute-based evaluation technique and, in spirit, are in keeping with a growing number of other small group (McDaniels, Gregory, and Fields 1999) and small sample (Shabman and Stephenson 1996) comparisons of alternative benefit estimation approaches.

Willingness to Pay

For the VIS, willingness-to-pay valuations of policy alternatives were obtained through the constructive process outlined above, with each respondent's assessment of the forest job used to calculate, in dollars per unit, values for each of the other six dimensions. Participants were asked to evaluate the three program options, as previously shown in Figure 7. Each program was composed of the same seven value dimensions but attribute impact levels varied across the three programs. For this experimental application of the VIS approach, the assumption of linearity in single attribute utility functions (over the relevant range of impacts) allowed participants to value the expected changes in each dimension that would be provided by the specified program alternative. For the purpose of the summary program evaluation, all entries were made in dollars. Thus, if the addition of one forest job was worth $50,000, the participant calculated that the value of eight additional forest jobs was $400,000. An example of these results, for a representative participant, is shown in Figure 8.[7]

VIS results for all participants are shown in Figure 9. For Policy A, offering 75% protection, responses of the 14 participants ranged from a high willingness-to-pay value of $29.88 to a low of $3.75. For Policy B, the corresponding high and low willingness-to-pay values were $19.25 and $2.43, respectively, and for Policy C the willingness-to-pay values were $9.60 and $1.17. Both the magnitude and range of these responses are within the bounds of what might be expected for a program of this type.

For the CVM survey, participants' willingness-to-pay valuations are based on results of a logit analysis of the dichotomous choice referendum questions for the same three policy alternatives. As shown in Figure 9, the unrestricted mean responses range from $41.36 per person (for Policy A, offering 75% protection) to $11.70 per person (for Policy C, offering 25% protection). These CVM results are nearly the same as those from the U.S.F.S. study headed by Loomis;

[6] An important research question concerns the ability of respondents to make informed judgments across several attribute sets. In this study subjects were asked to consider 3 alternatives whereas in the choice experiments of Adamowicz et al. (1998), for example, each respondent considered 8 scenarios. The issue, once again, is breadth vs. depth: a higher number of scenarios facilitates statistical comparisons of choices but may also lead to less informed judgments.

[7] Much can be done to strengthen the VIS approach in ways that will allow it to mirror more faithfully the cognitive and decision processes of survey participants. For example, computers and other visual tools (video, photographs) could be used to improve the display of information related to designated objectives. Computer displays also could be used to enable participants to more fully construct desired policy alternatives, by combining value dimensions in novel ways (rather than valuing pre-set alternatives, as reported in the case study) and to learn (through feedback) about the project or policy implications of their stated preferences.

Value Dimension	$ Worth of one unit	Program A $ 000	Program B $ 000	Program C $ 000
TIMBER HARVEST	$1,000/ 000 bd ft	800	500	300
FOREST JOBS	$3,000 per job	45	24	12
FOREST RECREATION	$550 per day	756	412	344
FISH HABITAT	$12,500 per mile	32	20	5
FOREST PRESERVATION	$2,500 per acre	13,125	8,750	4,375
DOLLAR COST	$	7,750	6,000	4,250
FIRE FIGHTER INJURIES	$150,000 per injury	1,350	900	450

FIGURE 8
DISAGGREGATED ASSESSMENT OF PROGRAM OPTIONS (FOR ONE PARTICIPANT)

we would have been concerned had they been significantly different, because (as noted earlier) this survey closely mirrors the earlier valuation effort.[8]

As shown in Figure 9, median dollar values for the VIS are about one-fourth the magnitude of the unrestricted mean values from the CVM survey. This difference is not surprising, because CVM- and MAUT-based approaches look for a valuation response in quite different ways: as previously discusssed, the VIS approach assumes a context specific, constructed basis for preference elicitation, whereas a CVM approach seeks to measure a latent value that reflects the consumer surplus estimates of the participating individuals. This distinction is fundamental, and indicative of a different conceptual basis for measuring value. Willingness-to-pay estimates provided by a CVM measure are readily interpreted as consumer surplus within the structure of neoclassical economics. Yet, as pointed out by Shabman and Stephenson (1996, 446), "quantification need not mean the common denominator of willingness to pay as measured in dollars." Keeping in mind the experimental nature of this particular application, a constructive process allows each participant to use their component dimensions of value as "building blocks" with which a preferred alternative can be assembled (Payne, Bettman, and Schkade 1999). In particular, the adoption of a trade-offs perspective for generating values in a VIS simultaneously (1) moves the analysis away from a traditional consumer surplus measure of value;[9] and (2) enhances the policy relevance of the value estimates, because it helps decision makers to construct a policy alternative that reflects and addresses the

[8] As reported by Loomis, Gonzalez-Caban, and Gregory 1996, the CVM mean WTP responses obtained in two versions of their study were $35.88 and $32.96, with the (respective) range of values at the 95% confidence interval equal to $29.23–$42.52 for version 1 and $24.79–$41.13 for version 2. The only difference between versions is that version 2 included a reminder of substitute uses of money, as recommended by the NOAA panel; however, responses were not significantly different between survey versions.

[9] As noted earlier, this is not to imply that a CVM format provides a traditional economic measure of value. There is currently extensive debate on the meaning of dollar valuations of environmental goods and whether willingness-to-pay responses might best be interpreted as expressions of respondents' willingness to contribute to good causes (Kahneman and Knetch 1992) or attitudinal intensity rather than indicators of economic preference (Kahneman and Ritov 1994).

		Program A* 75% protection	Program B 50% protection	Program C 25% protection
Value Integration Survey, N = 14	High	29.88	19.25	9.60
	Low	3.75	2.43	1.17
	Median	10.63	6.92	3.73
Contingent Valuation Survey (unrestricted means), N = 180		41.36	26.53	11.70

* Shown are individual WTP for fire control programs on an annual basis.

FIGURE 9
VALUATION OF PROGRAM OPTIONS USING VIS AND CVM APPROACHES ($WTP)

competing interests among stakeholders.[10] As described later in this section, between group comparisons of participants' satisfaction with the two evaluation methods further support the potential attractiveness of a constructive survey approach.

Value Tradeoffs

No information on value tradeoffs was developed in the CVM survey apart from the overall willingness-to-pay evaluation of designated program benefits, as discussed above.

Participants in the VIS were asked to make tradeoffs across each of the designated value dimensions in light of the anticipated impacts of the proposed resource policies. As described in Section 3, this task was completed in two steps, with relative tradeoffs first made across three sets of three dimensions (with one dimension repeated to allow translation of the tradeoff ratings) and, second, with an absolute value assigned to one dimension.

These responses are shown in Figure 10, which presents the range of normalized responses for the seven value dimensions. Additional time for participants to reflect on the implications of the expressed tradeoffs and to address inconsistencies (e.g., in pairwise value weights) would doubtlessly lead to some refinements in these estimates. In our opinion, this would be time well spent because direct information about tradeoffs across dimensions is helpful to policymakers in understanding the reasons for stakeholder support of, or opposition to, specific resource management actions. In addition, the knowledge of tradeoffs across dimensions—and, in particular, the knowledge of which changes in dimensions are most highly valued by participants—helps to equip resource managers to fine-tune proposed actions (e.g., through mitigation or compensation initiatives) and thereby create win-win alternatives that are more likely to satisfy the concerns of multiple stakeholders. This advantage of a VIS approach relates to current uses of multiattribute methods as an aid to negotiations among stakeholder groups (Fisher, Ury, and Patton 1991).

Participant Satisfaction

At the end of the survey, participants in the VIS were asked to rate their satisfaction

[10] One possible exception to this point is the far-reaching influence of executive orders and other federal-government policies that are widely interpreted as requiring adoption of a benefit-cost framework for analyses of environmental projects.

Value Dimension	High	Low	Median
1. TIMBER HARVEST	.11	.05	.07
2. FOREST JOBS	.25	.06	.11
3. FOREST RECREATION	.24	.11	.13
4. FISH HABITAT	.23	.17	.21
5. FOREST PRESERVATION	.29	.13	.21
6. DOLLAR COST	.11	.08	.09
7. FIRE FIGHTER INJURIES	.27	.06	.17

FIGURE 10
NORMALIZED VALUE TRADEOFFS ACROSS DIMENSIONS

Satisfaction Scale*	Mean Results CVM $N=185$	Mean Results VIS $N=14$
1. How sure are you that your true value lies within your (stated) range?	5.96	5.03
2. Is this a good way to provide public input into decisions about programs like this?	4.96	5.57
3. Not enough information to make well-considered responses.	4.13	3.08
4. Process helps me to understand and express my values.	3.88	6.05
5. Process was too complicated and difficult to understand.	2.13	1.56
6. I enjoyed the questionnaire.	3.93	5.75

* Scale used for question 1 was 1 = very unsure; 7 = very sure.
Scale used for questions 2-6 was 1 = strongly disagree; 7 = strongly agree. However, these questions were at the end of a long task; therefore, the direction of responses was varied to avoid an agreement bias. For questions 2, 4, and 6, a higher numerical response denotes greater satisfaction with an approach. For questions 3 and 5, a lower numerical response denotes greater participant satisfaction.

FIGURE 11
COMPARISON OF PARTICIPANTS' SATISFACTION, CVM, AND VIS APPROACHES

with, and confidence in, the elicitation process and the evaluation outcomes. These results were compared to similar questions asked of participants in the CVM survey. The questions used to assess participants' satisfaction, and the mean responses of participants using both CVM and VIS techniques, are shown in Figure 11.

Given the methodological objectives of this paper, the comparison across satisfaction ratings for VIS and CVM methods is important. It demonstrates—at least for these participants and for this case study context—that the VIS approach sucessfully meets several of its objectives: participants report additional understanding of their relevant values, (Question 4), and are sufficiently confident with the level of factual information accessible to them, (Question 3), that they consider a VIS to be a good way to provide public input, (Questions 2 and 5). For each of these satisfaction questions, mean responses to the VIS dominate those given for the CVM. However, the VIS approach also appears to have fostered a greater appreciation of the complexity of such value-elicitation tasks, as shown in the somewhat higher mean response to Question 1.

Several caveats accompany this upbeat review of results. First (as previously noted), samples were not drawn from identical populations and this could influence results, as could the small number of participants in the VIS approach. Second, the VIS and CVM were completed under different experimental conditions, with VIS participants responding to an advertisement and completing the questionnaire at a single site rather than (as for the CVM participants) responding to a random mailing and completing the questionnaire in the privacy of their own home. How these differences affect the comparison of mean satisfaction responses is not known, but the issues bear further scrutiny.

V. CONCLUSION

Value integration and other multi-attribute environmental policy surveys are still in the experimental stage, whereas contingent valuation methods have been used widely for over two decades. It is hoped that this VIS discussion will help to inform policymakers about an alternative approach to environmental valuation and about conditions under which they might choose to consider the use of multidimensional, constructive survey approaches for creating and evaluating project or program options. In particular, we suggest that the use of an attribute-based, constructive survey approach should be considered in cases where the policy or action has many (potentially conflicting) dimensions or is likely to be unfamiliar to respondents, where key dimensions of the problem are not easily thought about in dollar terms, and where the decision context reflects a search for common agreement through a multiparty dialogue among stakeholder groups.

What appear to be the principal advantages of a VIS approach? Following the discussion in Section 2 and the results presented in Section 4, four aspects appear to be particularly helpful:

1. identifying explicit value dimensions, which aids participants in understanding both their own values and the impacts of a proposed environmental initiative;
2. addressing trade-offs across these dimensions, which provides information to policymakers as an aid to stakeholder negotiations and as part of designing mitigation or compensation packages to enhance the acceptability of a project;
3. using prioritized value dimensions to select a preferred policy option, which empowers direct stakeholder input to decisions; and
4. selecting from among competing project options, which allows participants to consider alternative proposals and to inform policymakers about their preferences across project characteristics.

The complex environmental context selected for this study—fire control policies in old-growth forests—admittedly is a difficult one for experimentation with a new technique. In particular, it has the unusual evaluative problem that some participants view fire as a good, at least across some dimensions

(e.g., wildlife habitat or timber harvest), and some as a bad. However, the complexity of evaluating fire protection programs also provides an example of a policy initiative for which constructive survey processes should be most helpful: evaluating the complex, multidimensional impacts of policies that are characterized by a variety of economic and non-economic consequences.

Additional information on this point will come from several current tests of the VIS in other environmental policy settings, where the method is being applied with larger sample sizes as an aid to help diverse stakeholders clarify their values and select from among competing resource management plans.[11] Several methodological advances are now being tested. One example is the development of sequenced questions designed to move from linear value assumptions by fine-tuning participant's expressed willingness to pay for different levels of benefits. A second example, encouraged by the apparent ease with which most participants were able to complete the required VIS tasks, is a mail version of the VIS. This alternative promises substantially larger sample sizes but also requires some changes, including revisions to the instructions provided at the start of the survey as well as in the calculations of trade-off values and the debriefing provided to encourage participants to reconsider their responses. A third example, stimulated in part by the insights gained in choice experiments and other stated preference methods (Boxall et al. 1996), encourages respondents to create new and better policy alternatives by presenting them with a wider menu of measures and attribute levels. Incorporating these types of changes into new studies will provide valuable additional information on the ability of constructive approaches to respond to the cognitive and institutional challenges associated with evaluating complex environmental policy options.

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